CLAIMS

What is claimed is:

1. An apparatus for cutting an elongate workpiece along a cutting path with a cutting tool, said apparatus comprising:

a workpiece drive adapted to selectively move a supported workpiece in the direction of an X-axis in a mutually orthogonal X, Y, and Z-axis coordinate system;

a tool mount, including

a first rotatable carrier having a first axis of rotation and a first drive gear,

a second carrier carried by said first carrier for rotation about a second axis, said first and second axes being spaced apart,

gear teeth on said second carrier, said gear teeth being circular about said second axis,

a tool holder adapted to secure the tool to the second carrier with the tool oriented generally parallel to and spaced from the second axis, and

a ring gear rotatable about said first axis and engaging said gear teeth on said second carrier;

a drive mechanism adapted to selectively drive said first drive gear and said ring gear to selectively position and move said tool; and

a guide ring adapted to support said tool mount for motion in said Y and Z directions and for rotational movement about a workpiece.

2. The apparatus of claim 1, wherein said first and second axes are spaced apart a distance S and said tool and said second axis are spaced apart a distance T, whereby said apparatus is adapted to cut paths fitting within a circle having a radius S + T.

3. The apparatus of claim 2, wherein S = T whereby said apparatus is adapted to cut any path fitting within a circle having a radius S + T.

4. The apparatus of claim 1, wherein said drive mechanism includes first and second drives which are adapted to selectively drive said first carrier and said ring gear, respectively, through different angles of rotation to position said tool at a selected distance from said first axis of rotation.

5. The apparatus of claim 1, wherein said drive mechanism includes a first drive and a second drive which are adapted to drive said first drive gear and said ring gear, respectively, at an equal rate of rotation whereby said tool is moved in a circle about said first axis of rotation.

6. The apparatus of claim 1, wherein said drive engages said ring gear, and further comprising:

a first drive lock locking said first carrier to said ring gear when said ring gear is driven in a first direction of rotation; and

a second drive lock preventing rotation of said first carrier when said ring gear is driven in a second direction of rotation opposite the first direction of rotation.

7. The apparatus of claim 1, further comprising a tilt support between said guide ring and said tool mount, said tilt support being selectively tiltable relative to a workpiece surface lying generally in said X-Y plane to compensate for the angle of the side of the kerf or to provide a selected bevel cut.

8. An apparatus for positioning a tool relative to a workpiece, comprising:

a first carrier rotatable on a first axis;

a second carrier carried by said first carrier and rotatable about a second axis defined by said first carrier, said second axis being in a parallel and offset eccentric relationship to said first axis;

a tool holder associated with said second carrier in an offset eccentric relationship to said second axis; and

a drive mechanism selectively rotatably driving said first carrier about said first axis and said second carrier about said second axis to selectively position said tool holder.

9. The apparatus of claim 8, wherein said tool may be selectively positioned within an area circular about the first axis, said area having a radius which is the sum of the eccentric relationship of the second carrier to the first axis and the eccentric relationship of the tool holder to the second axis.

10. The apparatus of claim 8, wherein said first and second axes are spaced apart a distance S and said tool holder and said second axis are spaced apart a distance T, whereby said apparatus is adapted to cut paths fitting within a circle having a radius S + T.

11. The apparatus of claim 10, wherein S = T whereby said apparatus is adapted to cut any path fitting within a circle having a radius S + T.

12. The apparatus of claim 8, further including:

external gear teeth on said second carrier;

a ring gear rotatable about said first axis and engaging said external gear teeth on said second carrier;

a first drive for selectively rotating said first carrier; and

a second drive for selectively rotating said ring gear.

13. The apparatus of claim 12, wherein said first drive and second drive are adapted to drive said first carrier and said ring gear at an equal rate of rotation whereby said tool holder is moved in a circle about said first axis of rotation.

14. The apparatus of claim 8, further comprising:

external gear teeth on said second carrier;

a ring gear rotatable about said first axis and engaging said external gear teeth on said second carrier;

a drive for selectively rotating said ring gear;

a first drive lock locking said first carrier to said ring gear when said ring gear is driven in a first direction of rotation; and

a second drive lock preventing rotation of said first carrier when said ring gear is driven in a second direction of rotation opposite the first direction of rotation.

15. The apparatus of claim 8, wherein:

said first carrier includes a sleeve having a cylindrical receiving bore that defines said second axis; and

said second carrier includes

a cylindrical exterior portion rotatably received within said cylindrical receiving bore, and

an external gear circular around said second axis.

16. The apparatus of claim 15, further comprising a ring gear rotatable about the first axis and engaging said second carrier external gear, said ring gear having a radius substantially equal to the radius of the external gear plus the eccentric distance between said first axis and said second axis.

17. The apparatus of claim 8, wherein said first and second axes are substantially parallel to an X-axis in a mutually orthogonal X, Y, and Z-axis coordinate system, and said first carrier is supported on a guide ring adapted to support said first carrier for motion in said Y and Z directions and for rotational movement about said X-axis.

18. The apparatus of claim 17, further comprising a workpiece drive adapted to selectively move a supported workpiece through said guide ring in the direction of the X-axis.

19. The apparatus of claim 18, further comprising a tilt support between said guide ring and said tool holder, said tilt support being selectively tiltable relative to a workpiece surface lying generally in said X-Y plane to compensate for the angle of the side of the kerf or to provide a selected bevel cut.

20. A method of moving a tool relative to a workpiece using a first carrier rotatable about a first axis, comprising the steps of:

mounting the tool to a second carrier rotatably carried by said first carrier for rotation about a second axis defined by said first carrier, said second axis being eccentric to said first axis and said cutting tool being eccentric to said second axis; and

moving said tool along a selected path by selectively rotatably driving said first carrier about said first axis and said second carrier about said second axis.

21. The method of claim 20, wherein said first and second carriers are separately rotatably driven during said moving step.

22. The method of claim 20, further comprising the step of supporting said second carrier in driving engagement with internal teeth of a ring

gear rotatable about said first axis, wherein during said moving step said tool is selectively moved by selectively driving said first carrier and said ring gear.

23. The method of claim 22, wherein said tool is moved to cut a cylindrical hole, and said moving step comprises:

rotating said first carrier and said ring gear to locate said tool at a distance from the first axis equal to the radius of the cylindrical hole;

aligning said tool relative to said workpiece whereby said first axis coincides with the axis of said cylindrical hole to be cut; and

cutting said cylindrical hole with said cutting tool while rotating said first carrier and said ring gear at an equal rate of rotation about said first axis.

24. The method of claim 23, further comprising the steps of:

locking said first carrier against rotation in one direction; and

locking said first carrier and said ring gear against relative rotation when said ring gear is rotated in the direction opposite said one direction.

25. The method of claim 23, further including the step of restraining the workpiece against movement during cutting of said cylindrical hole.

26. The method of claim 20, wherein said workpiece is selectively moved in the direction of an X-axis in a mutually orthogonal X, Y, and Z-axis coordinate system and said tool cuts a workpiece surface lying generally in the X-Y plane.

27. The method of claim 26, further comprising positioning said cutting tool in an initial cutting position by moving said tool in the Y and Z plane.